Improvements in or Relating to Pipes

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This invention is concerned with improvements in or relating to pipes and a method of manufacturing same, particularly but not exclusively to corrosion resistant pipes adapted for use with liquids having high chemical concentrations or of a corrosive nature, or in cases where the liquid in the pipes should not be contaminated, such as a pipe conveying potable water. The invention may also be suitable for use in ground having a corrosive nature.

According to the present invention there is provided a pipe comprising a plurality of material layers, a core layer being formed of a composite material formed by a coalescence of materials, including an aggregate of materials providing strength and rigidity and a bonding agent, (hereinafter referred to as plastic concrete), and outer layers on respective sides of the core layer, each of the outer layers being formed of a plastics material.

The present invention further provides a method of manufacturing a pipe, the method comprising forming a pair of material layers from a plastics material, positioning the material layers in a spaced apart relation, and forming a core layer between the preformed material layers.

The core layer may be formed of plastic concrete and may be introduced in a flowable state between the preformed material layers to be moulded therein. The preformed material layers provide formwork for the moulding. The preformed material layers are moulded and are retained in their moulds to provide the formwork for moulding of the core layer.

The plastic concrete may be adjusted so as to commence curing within a short time of being introduced between the preformed material layers, whereby lower layers of the plastic concrete cure when further layers of the plastic concrete are introduced.

The present invention also provides a mould assembly for moulding a pipe, the assembly comprising a plurality of moulds formed of polymer

concrete.

An embodiment of the present invention will now be described by way of example only, with reference to the accompanying drawing, the single figure of which is a diagrammatic section through a mould assembly for producing a pipe.

A pipe, for use as a sewage pipe, is formed by producing a sandwich construction in the form of two preformed laminates on respective sides of a core material. The laminates may each be formed from a synthetic resin and the core may be a composite material formed from plastic concrete which provides the required stiffness and strength for the structure. The bonding agent is a thermosetting resin, for example polyester, epoxy, acrylic, vinylester, polyurethane or phenolic, or can be a thermoplastic resin, for example polyvinylchloride, polypropylene or polyurethane. The aggregate can be an inorganic material, for example any of silica sand, silica powder, calcium powder, gravel, stone chippings, ceramic powder or ceramic chippings, or any combination thereof. To provide further strength, other types of reinforcement can be included in the plastic concrete, such as glass, metal or plastic fibres. By using a synthetic resin in forming the laminates and the core, the bond between the laminates and the core can be improved and the core becomes more of an integral part of the laminates.

Referring to the drawing, the two preformed laminates are in the form of reinforced plastic pipes or tubes 10, 12, formed by filament winding a pipe, by hand lay up, or by forming a sheet which is then rolled and bonded to form a tube. A mould assembly is provided which comprises a base ring mould 14 and a top ring mould 16. The inner tube 10 locates in the mould assembly to extend between the base ring mould 14 and the top ring mould 16. The outer tube 12 also extends between the moulds 14, 16, locating in respective slots in the ring moulds. A cone 18 locates above the mould 16 and assists in guiding the plastic concrete when it is poured into the annular space between the tubes 10, 12. The cone 18 also centrally locates the inner tube 10. After completion of the casting of the plastic concrete, as hereinafter described, the cone 18 is

removed and a mould 20 is fitted, further plastic concrete then being poured into the gap between the pipe 10 and the mould 20 to form the top spigot of the pipe. All of the moulds 14, 16, 18 and 20 are held together by tie bars.

The moulds 14, 16, 18 and 20 are cast in polymer concrete so as to reduce costs. From one machined mould there can be cast numerous polymer concrete moulds so that the unit cost is lower and the polymer concrete moulds can be produced on site.

By adjusting the thickness and type of materials used in the inner and outer tubes 10, 12, the finished pipe can be designed to have different properties. In pressure pipes, the inner tube 10 can be designed to be strong enough to take all the pressure, the plastic concrete and the outer tube 12 providing stiffness and structural integrity. In pipes used to convey potable water, the inner tube could be made from materials which are non-toxic, such as epoxy, which would not contaminate the water in the pipe.

The ability to adjust the thickness has the advantage that it enables substantially different types of pipe to be produced. For example, the following pipes can be produced: pressure pipes; gravity pipes for carrying potable water, sea water, contaminated water; or pipes for carrying chemicals or acids. Where the pipe is to be buried, the ability to adjust the thickness means that the thickness of the outer layer can be increased to make the pipe able to withstand greater loads without increasing the overall diameter of the pipe. It has also bee found that by slightly adjusting the thickness of the two layers, the pipe strength can be adjusted.

By adjusting the mixture of the plastic concrete, the latter can start to cure within a few minutes of being poured. By also adjusting the volume of plastic concrete being poured and maintaining a constant vibration to ensure that the plastic concrete is consolidated and air pockets are removed, it is possible to cast pipes over 6 metres in length without providing any support to either of the inner or outer tubes 10, 12. Support is not required because the head of liquid plastic concrete changes as the lower layers of the plastic

concrete cure. This also means that the thickness of the inner and outer tubes 10, 12, can be reduced to save costs. When using a pipe as a jacking pipe, the length is not important, being restricted to the size of the shaft and the machine. However when a pipe is used for conventional open trench laying, longer pipe lengths are preferred, reducing the number of joints and speeding up installation. The time to lay any length of pipe is basically the same, and as the weakest point of any pipe is the joint, the more joints there are, the more there are potential problems.

It is also possible for a pigment to be added to one or both of the inner and outer tubes 10, 12. The pipes produced can be colour coded so that, for example, pipes for potable water are coloured blue, pipes for sewage are coloured black, and pipes for effluent are coloured green. In effect, this would enable pipes to be coloured to conform to the international pipe identification standards.

Pipes can be produced by the method described herein to meet the following standards, namely: ASTM D3262 fibreglass (glass-fibre-reinforced-thermosetting-resin) sewer pipes; ASTM D3754 fibreglass (glass-fibre-reinforced-thermosetting-resin) sewer and industrial pipes; ASTM D3517 fibreglass (glass-fibre-reinforced-thermosetting-resin) pressure pipes. These standards were introduced for pipes produced by spinning. However, pipes produced by the above described method have high strength but are produced at reduced cost.

With previous methods of constructing pipes using plastic concrete, a pipe has required to have a large cross-section to be strong enough, thereby increasing the weight of the pipe. Although this does not cause a particular problem when the pipe is to be used as a micro tunnelling pipe, the weight of the pipe is important with conventional open trench applications. In many cases a crane cannot be positioned alongside where the pipe is to be laid and this means that in order to lift the pipe the crane would need to have its jib extended, which reduces its load carrying capabilities. Also with previous methods an inner liner has had to be strong enough to resist buckling loads

caused by the head of the plastic concrete when being poured. This increased cost and the liner cost often became as much as 75% of the cost of the finished pipe. Where a thick liner is used, pipe length is restricted, unless there is provided an internal support shutter which is difficult to manufacture and remove without damaging the inner liner. If a collapsible mandrel is used, this makes the mould cost prohibitive, and it is difficult to make a collapsible mandrel over 3 metres.

Further, if the plastic concrete was to be completed in stages, problems arise in achieving a suitable bond between the layers of plastic concrete. As the latter would be poured from the top, it would adhere to the liners and cure, so restricting the flow when the next batch of plastic concrete is poured. Also air pockets would be caused in the plastic concrete as the uncured plastic concrete would form around the previously cured material.

In addition, previous pipe mould assemblies have used metal shutters which are expensive to manufacture and are restricted in length, making it necessary to join segments together. Such joints make the overall shutter very heavy and often difficult to produce. An outer abrasive resistance surface for the pipe has to be applied to the inner face of the shutter by hand, which takes time, and the lining has to cure before the shutter mould can be assembled to the other moulds. Due to the weight of the shutter and its height, an overhead crane is required and it takes time to assembly and disassemble the shutter. Also previously, ring moulds have been machined out of steel and were therefore expensive and heavy, increasing cost.

A pipe which is manufactured as hereinbefore described, using the mould assembly of the drawing, can be easily produced on site and meets the following requirements:- lightweight but strong; low cost; corrosion resistant; easy to install; and available in large volumes. Large pipe projects stretch for many miles and transportation of pipe can be a big cost, particularly if the pipes have to be imported. To produce a pipe as hereinbefore described requires very little capital investment and no major infrastructure, only a covered area with a flat concrete floor. On completion, equipment can be removed to another site.

Various modifications may be made without departing from the invention.